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(54) Swivel coupling

(57) A swivel coupling (1) for attachment to human or animal bone comprises a main body (2) consisting of first and second clamping elements (4, 6) which are clamped together by means of a threaded fastener (10). A first connection element comprising a substantially spherical annular coupling (24) is located between the clamping elements (4, 6) and in a relaxed state of the threaded fastener (10) is able to swivel relative to the main body (2). When the threaded fastener (10) is tightened, the clamping elements (4, 6) are brought together

to clamp the connection element (24) in a fixed position relative to the main body (2). A bone engaging element such as a bone screw or hook (32), or a spinal correction rod may be fitted to the connection element (24). In a preferred embodiment, two connection elements (24, 70) are provided, both of the connection elements (24, 70) being clamped when the threaded fastener (10) is tightened. In this preferred embodiment, a bone screw or hook (32) may be fitted to one of the connection elements (24) and a spinal correction rod may be fitted to the other connection element (70).

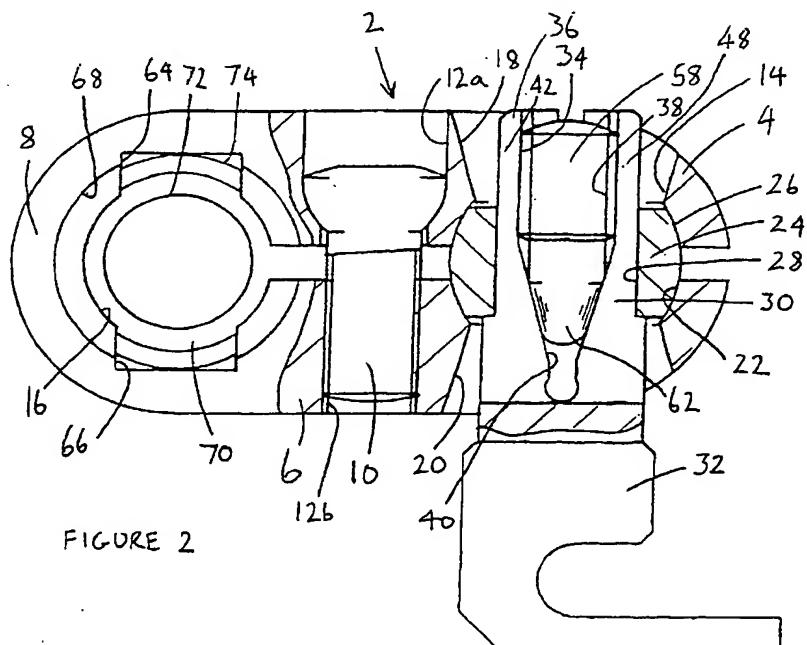


FIGURE 2

vention and to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:-

- Figure 1 is a top view of a swivel joint coupling in accordance with the present invention;
- Figure 2 is a cross-section through a swivel joint coupling and bone engaging hook in accordance with a first embodiment of the present invention;
- Figure 3 is a side view of a part-spherical second connection element; and
- Figure 4 is a view from above of the second connection element of Figure 5;
- Figure 5 is a view from above of a second embodiment of swivel coupling;
- Figure 6 is a cross-section through a second embodiment of swivel coupling.

Detailed Description of Preferred Embodiments

[0020] Referring to Figures 1 and 2, a swivel coupling 1 in accordance with the first embodiment of the present invention comprises a main body 2 which is machined from stainless steel or titanium or any other medically acceptable material with appropriate mechanical properties. The body portion 2 is divided into first and second clamping elements 4, 6 which are interconnected at a first end 8 of the main body 2.

[0021] A tightening element in the form of a machine screw 10 is located in aligned openings 12a, 12b formed through the first clamping element 4 and second clamping element 6 respectively. The first opening 12a comprises a counter sink which receives the head of the machine screw 10 and the second opening 12b comprise a threaded bore into which the threads of the machine screw 10 engage.

[0022] Two large cavities 14, 16 are formed in the main body 2 on opposite sides of the openings 12a, 12b. The first cavity 14 comprises a pair of conical openings 18, 20 which taper inwardly towards a central spherical region 22. A connection element comprising an annular coupling 24 is located in the central spherical regional 22 of the first cavity 14. The radially outer surface 26 of the annular coupling 24 is spherical and fits within the central spherical region 22 of the first cavity 14 with sufficient clearance to allow the annular coupling 24 to swivel relative to the main body, when the machine screw 10 is loose.

[0023] An opening 28 is formed through the annular coupling 24. The opening 28 receives a collet portion 30 of a bone engaging element in the form of a bone hook 32. A bore 34 is formed in an open end 36 of the collet portion 30. The bore 34 comprises a threaded bore portion 38 which opens into a smooth walled tapered portion 40.

[0024] The collet 30 is split into four identical tangs 42, 44, 46, 48 by four equidistantly spaced slots 50, 52, 54, 56 which extend from the open end 36 of the collet

portion 30 to a position midway along the length of the tapered portion 40 of the bore 34. A grub screw 58 engages in the threaded portion 38 of the bore 34. The grub screw 58 has a tapered nose portion 62 which cooperates with the tapered portion 40 of the bore 34.

[0025] The second cavity 16 comprises a pair of substantially rectangular recesses 64, 66 which extend through the full width of the main body 2 in a direction substantially perpendicular to a central axis of the machine screw 10. The recesses 64, 66 open into a central spherical region 68 of the cavity 16. A second connection element comprising an annular coupling 70 is housed within the central spherical region 68.

[0026] Referring to Figures 3 and 4, the second annular coupling 70 is provided with a spherical outer surface 74 and an opening 72 which extends along a central axis X-X of the second annular coupling 70. A slit 76 extends through the full radial and axial widths W1, W2 of the annulus of the annular coupling 70. Furthermore, a plurality of slots 78 extend through the full radial width W1 of the annulus of the annular coupling 70 but do not extend for the full axial width W2.

[0027] In operation of the swivel coupling 1, with the machine screw 10 loose, a spinal correction rod (not shown) is inserted into the opening 72 formed through the second annular coupling 70, and the collet portion 30 of the bone hook 32 is inserted into the opening 28 formed in the first annular coupling 24.

[0028] With the machine screw 10 loose, the spinal correction rod and bone hook 32 can be angled relative to one another by swivelling the annular couplings 24 and 70 in their respective openings 28, 72 in the swivel coupling 1. When the desired angular position has been found, the machine screw 10 is tightened, thereby bringing together the first clamping element 4 and second clamping element 6 and fixing the first annular coupling 24 and second annular coupling 70 in position relative to one another and relative to the main body 2.

[0029] It will be appreciated that as the machine screw 10 is tightened, and the first and second clamping elements 4, 6 are brought together, the second annular coupling 70, which has the form of a collet, is itself compressed, so that the opening 72 through the second annular coupling 70 is reduced in diameter, thereby gripping firmly the spinal correction rod and preventing it moving in an axial direction along the axis X-X of the second annular coupling 70.

[0030] Once the desired degree of insertion of the collet portion 30 of the bone hook 32 into the first annular coupling 24 has been determined, its position can be fixed by screwing the grub screw 58 into the threads of the collet portion 30. As the grub screw 58 is driven down into the bore 34 the tapered tip portion 62 of the grub screw 58 forces the tangs 42, 44, 46, 48 of the collet portion 30 outwardly into engagement with an inside surface of the opening 28 formed through the annular coupling 24.

[0031] If, inter-operatively or post-operatively, it is

13. A swivel coupling as claimed in claim 11 or 12, when appendant to claim 9 or 10, in which a central axis of the opening in the first connection element is not parallel to the central axis of the opening in the second connection element.

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14. A swivel coupling as claimed in any one of claims 11 to 13, in which the second connection element is split, so that as the clamping elements are tightened on to the second connection element, the opening through the second connection element is reduced in diameter, thereby to provide a clamping action.

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15. A swivel coupling as claimed in any one of claims 11 to 14, in which the second connection element is provided with at least one slot which extends from the central opening to an outer surface of the second connection element.

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16. A swivel coupling as claimed in any one of claims 9 to 15, in which the second connection element is at least partially spherical.

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17. A device for attachment to human or animal bone comprising a bone engaging element and a connection element, the bone engaging element comprising a split collet, the open end of the collet being provided with an at least partially tapered bore in which is located a threaded element, the split collet being received within an opening formed in the connection element, the threaded element being screwed into the open end of the collet to splay the collet into contact with an internal wall of the opening formed in the connection element.

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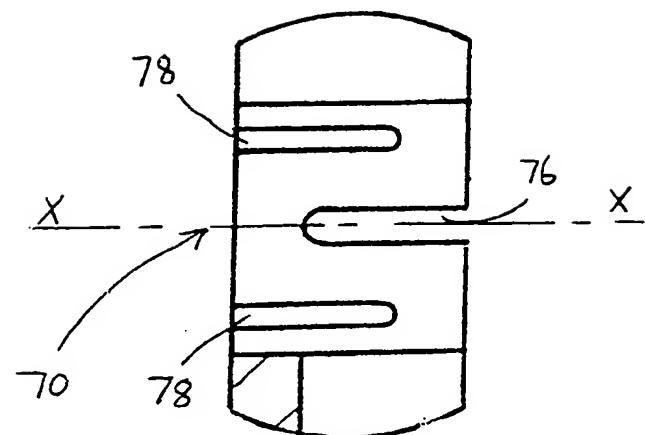


FIGURE 3 $\leftarrow w_2 \rightarrow$

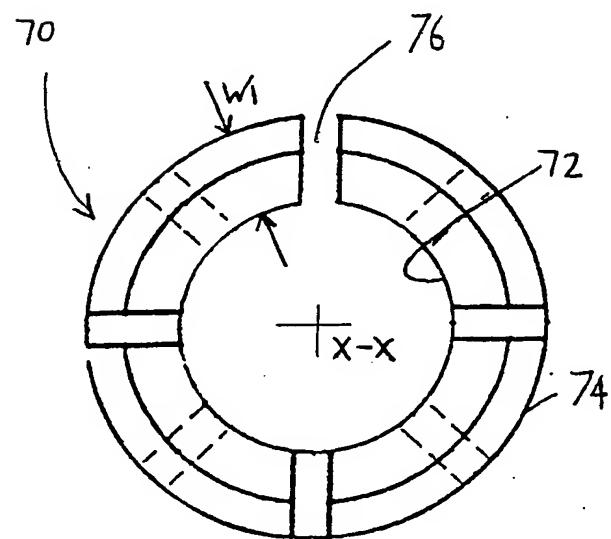


FIGURE 4

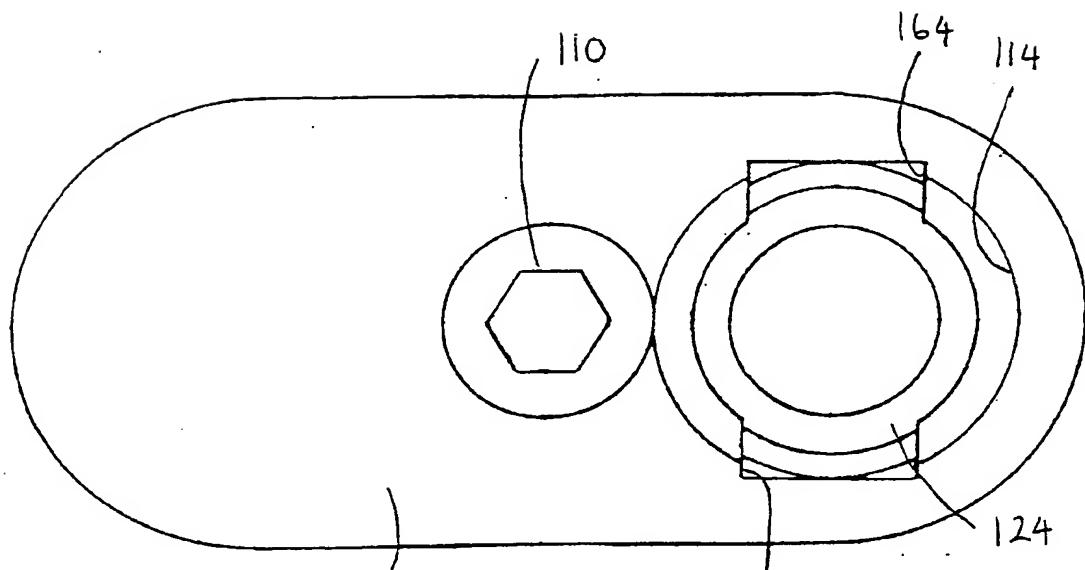


FIGURE 5 104

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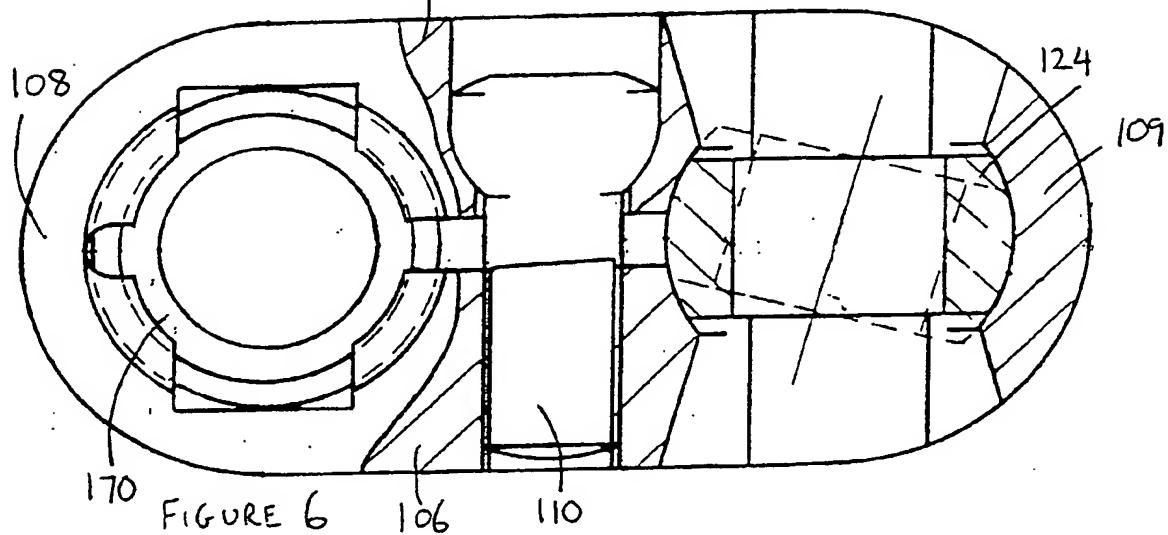


FIGURE 6

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